

LA-UR-18-23695

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Title: Process Engineering Workshop - PT2 Machining

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Intended for: Presentation

Issued: 2018-04-30

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Process Engineering Workshop

PT-2 Machining

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01/26/18



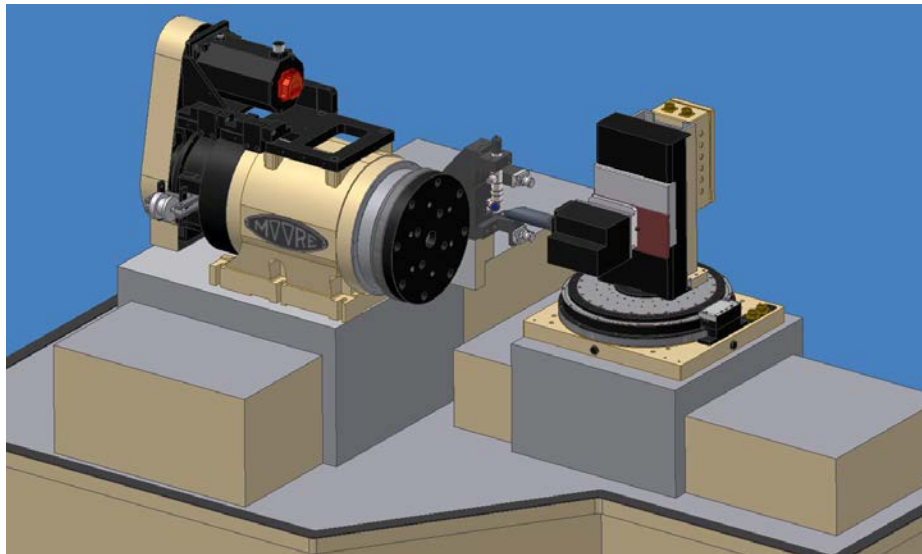
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So, what do we do??

- **Surveillance**
 - Coupons, Samples, Disassembly
- **Tooling**
 - Fixturing, Tooling, Misc.
- **Pit Production**

Hemishells (T-Base Lathe)



Drill & Press (DMU35 Mill)

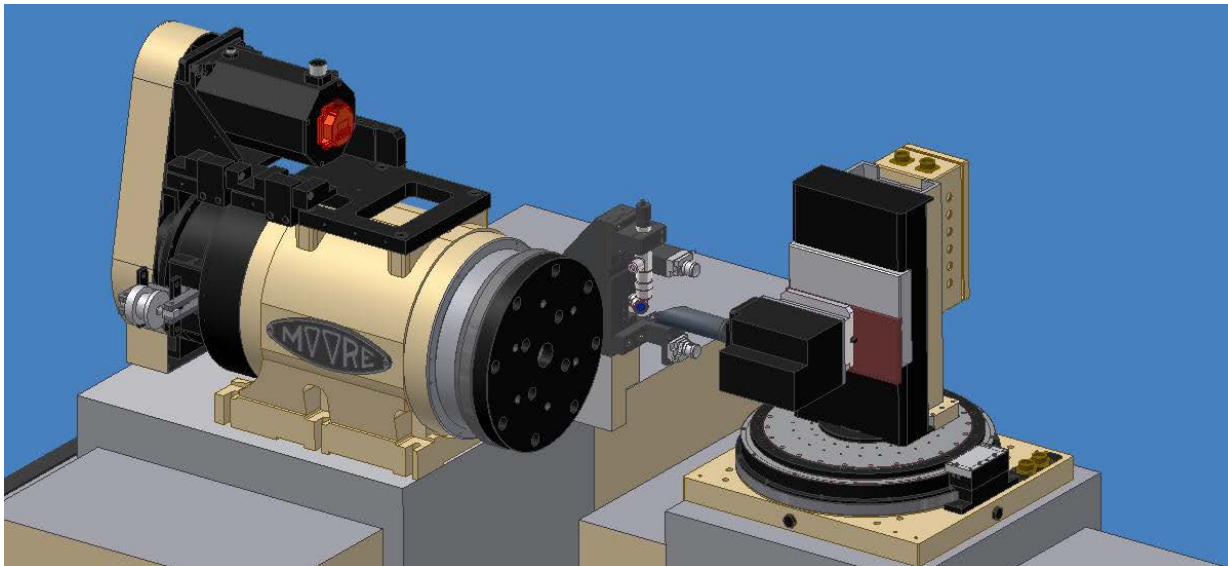


Hemishell Machining

[Similar to]
Inner Contour Fixture (U)



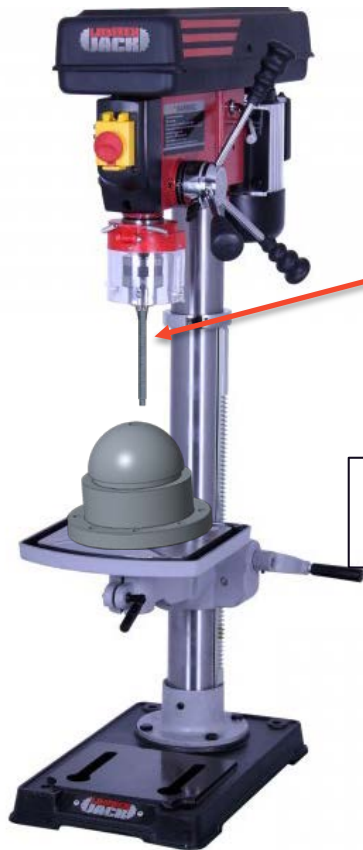
[Similar to]
Outer Contour Fixture (U)



Drill & Press: Manual to CNC

Switching Between Hemishell Designs

Manual



Unclassified

Stationary spindle - Need to switch fixture to accommodate various designs

Mobile spindle - No fixture change needed

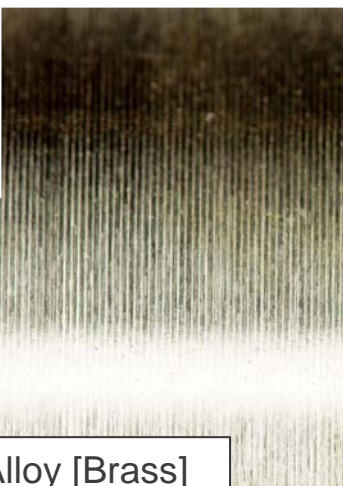
CNC



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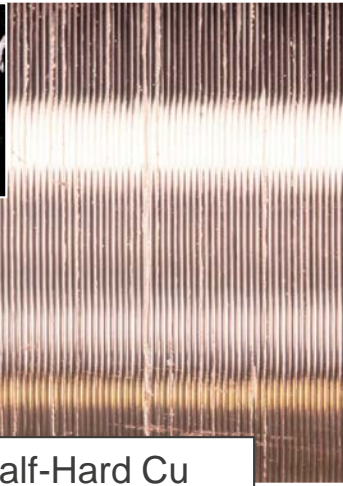
Material Matters

- **Microstructure of the material makes a difference**
 - Density
 - Ductility
 - Hardness
 - Grain boundaries
- **Alloys vs. Heat Treat vs. Annealing**



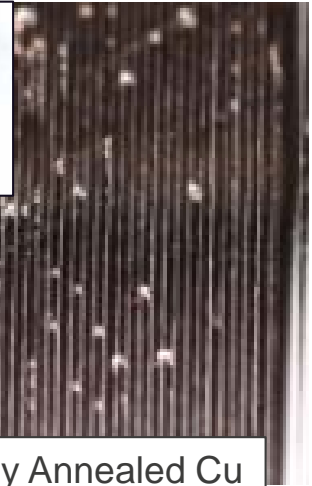
Cu Alloy [Brass]

No Smearing



Half-Hard Cu

Some Smearing

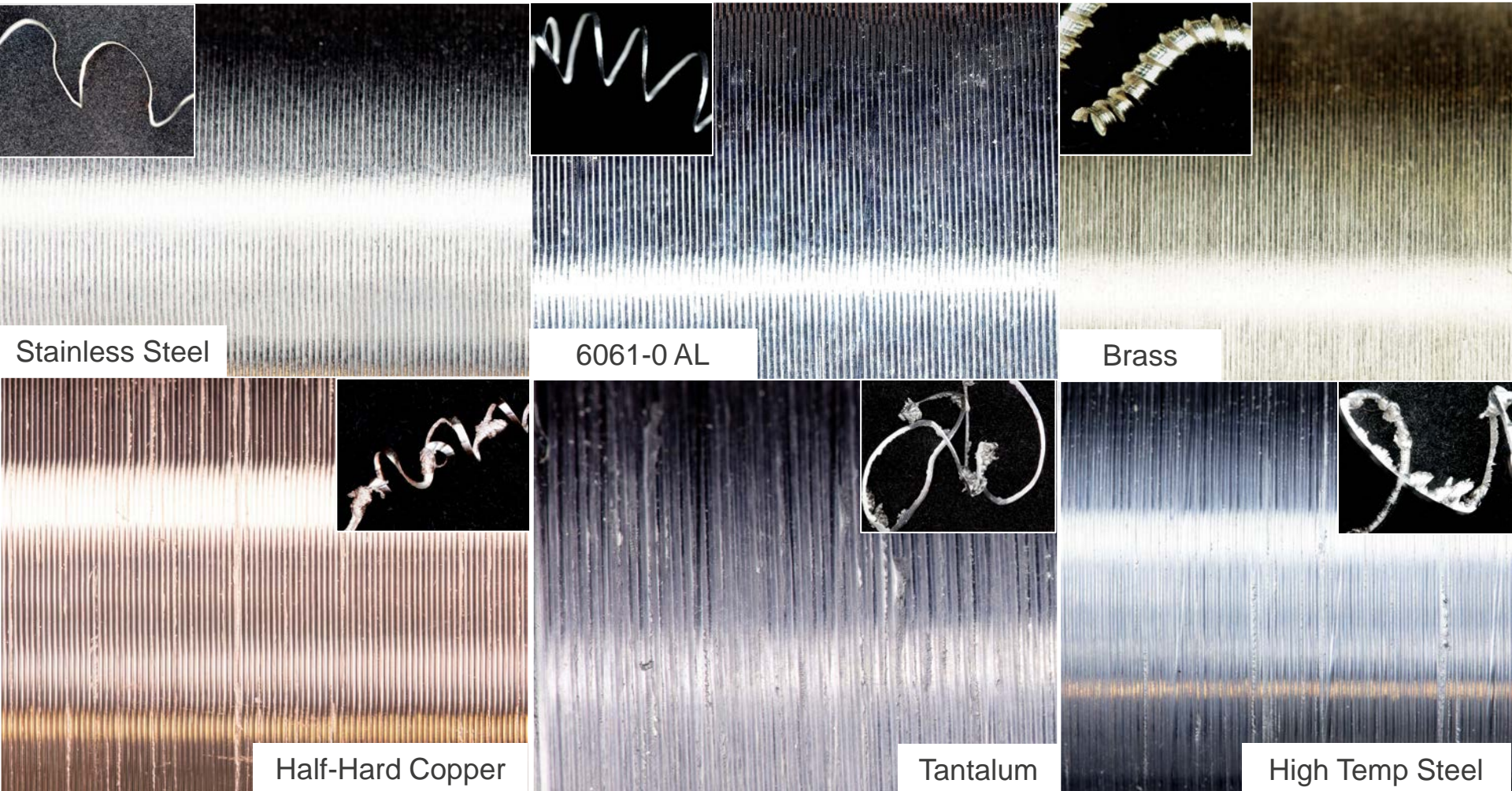


Fully Annealed Cu

Lots of Smearing
& Point Adhesion

Chip Formation & Surface Finish

- All at .005" depth of cut – constant speed & feed



Plutonium – the struggle is real

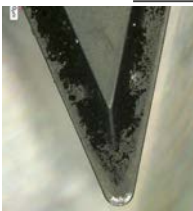
- **Pu is very dense and very ductile – like peanut butter**

- Makes it prone to smearing and tool edge build up

- **Mixed waste is expensive (like \$300,000/ft³ expensive)**

- Trying to move towards dry machining to reduce costs
- Without coolant, the chips get hotter and even more ductile
→ “gummy”
- Leading to even more smearing and tool build-up

w/ Chip Breaker

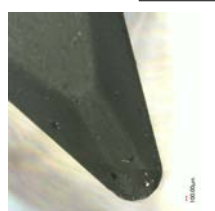


Source: LA-UR-13-20936



Source: LA-UR-13-20936

w/o Chip Breaker



Source: LA-UR-13-20936



- **Chip Accountability**

- The ergonomics of the glovebox make it difficult to recover ALL chips

Al vs. Pu



Source: LA-UR-13-20936

Plutonium – the struggle is real

- **Pu is not well understood**

- Machinists rely heavily on tribal knowledge and experience to know how a material behaves - i.e. What speeds and feeds to use
- Can't practice on Pu due to limited stock, casting variations, and material constraints
 - An adequate surrogate hasn't been found
- The inability to predict the material behavior makes it difficult to standardize

- **But we made good parts before -- What happened??**

- Before – we were making loads of Pu, and machinists had ample castings to machine (read: gain experience from)
- Now – There is very little Pu available for casting, and no [fresh] Pu will be made until the ER process is running again
 - All that we have has been recycled, and Pu changes over time, making each batch inconsistent, even with the same recipe
- With more hemishells to machine (aka data), we could do a process capability assessment, and better predict how the recipes machine --- but alas...

Questions?

